CLAIMS

What is claimed is:

1. An electrochemical cell having a membrane electrode assembly (MEA) comprising an anode and a cathode, the cell comprising:

an electroconductive element comprising an impermeable electrically conductive element having a major surface facing the cathode, and a porous liquid distribution media disposed along said major surface defining flow channels at said major surface for transporting gas and liquid to and from the cathode;

an electrically conductive fluid distribution layer disposed between said liquid distribution media and the cathode for transporting gases and liquids between the cathode and said flow channels; said fluid distribution layer and liquid distribution media constructed and arranged to transport liquids accumulating within the cathode through said fluid distribution layer and to and through said liquid distribution media.

2. The electrochemical cell of claim 1, wherein said impermeable electrically conductive element and said liquid distribution media are arranged together to define said flow channels.

3. The electrochemical cell of claim 1, wherein said liquid distribution media forms an electrically conductive path between said impermeable electrically conductive element and said conductive fluid distribution layer.

4. The electrochemical cell of claim 1, wherein said fluid distribution layer is porous and has an average pore size larger than the average pore size of said porous liquid distribution media.

5. The electrochemical cell of claim 1, wherein said liquid distribution media is relatively more hydrophilic than said fluid distribution layer.

6. The electrochemical cell of claim 1, wherein said liquid distribution media overlies substantially all of said major surface.

7. The electrochemical cell of claim 1, wherein said liquid distribution media is disposed in regions along said major surface defining separate spaced-apart flow channels at each of said respective regions.

8. The electrochemical cell of claim 1, wherein said liquid distribution media has an undulated configuration of peaks and valleys, wherein said peaks correspond to lands and said valleys correspond to grooves which constitute said flow channels.

9. The electrochemical cell of 1, wherein said porous liquid distribution media has an average pore size in the range of from about 0.2 to about 30 microns.

10. The electrochemical cell of claim 1, wherein said liquid distribution media internally re-distributes liquid water thereby minimizing differences in humidity along a face of the MEA.

11. The electrochemical cell of claim 1, wherein said electroconductive element comprises a second impermeable electrically conductive element having a second surface facing the anode and a second liquid distribution media that is attached along regions of said second surface, and a second fluid distribution layer is disposed between said electroconductive element and the anode, wherein said second liquid distribution media contacts said second fluid distribution layer.

12. The electrochemical cell of claim 1, wherein said liquid distribution media comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said second layer is relatively more hydrophilic than said first layer.

13. The electrochemical cell of claim 1, wherein said liquid distribution media comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said first layer has a larger average pore size than said second layer, such that liquid is transported at a higher rate in said first layer than in said second layer.

14. The electrochemical cell of claim 1, wherein said liquid distribution media has a first surface and a second surface, said first surface is in contact with the fluid distribution layer and has an undulating surface that corresponds to said flow fields, wherein said second surface is opposite to said first surface and meets with a surface of said impermeable electrically conductive element and is planar.

15. The electrochemical cell of claim 1, wherein said liquid distribution media is electrically conductive and selected from the group consisting of: mesh, screen, and foam.

16. The electrochemical cell of claim 1, wherein said liquid distribution media is constructed of material selected from the group consisting of: carbon, graphite, polymers, stainless steel, chrome and alloys and mixtures thereof.

17. The electrochemical cell of claim 1, wherein said liquid distribution media is formed of materials that are cast, coated, or sprayed onto said major surface.

18. The electrochemical cell of claim 1, wherein said liquid distribution media comprises a conductive polymer or a non-conductive polymer with conductive particles distributed therein.

19. The electrochemical cell of claim 18, wherein said liquid distribution media is cured by application of heat.

20. The electrochemical cell of claim 1, wherein said liquid distribution media comprises a plurality of conductive metal particles selected from the group consisting of: stainless steel, niobium, inconel, and mixtures thereof.

21. The electrochemical cell of claim 20, wherein said liquid distribution media is formed by sintering said plurality of conductive metal particles by application of heat.

22. The electrochemical cell of claim 1, wherein said impermeable electrically conductive element comprises a compound selected from the group consisting of: aluminum, titanium, stainless steel, and alloys and mixtures thereof.

23. The electrochemical cell of claim 1, wherein said liquid distribution media is formed by etching said major surface.

24. An electroconductive element for an electrochemical fuel cell, said element comprising:

an impermeable electrically conductive element having a major surface;

a conductive porous layer on said element along said major surface, said porous layer being hydrophilic and operable to transport water from regions of relatively high liquid concentration to regions of relatively low liquid concentration within said layer.

25. The electroconductive element according to claim 24, wherein said porous hydrophilic layer is in contact with a fluid distribution layer which is further in contact and fluid communication with an electrode, and said porous hydrophilic layer is relatively more hydrophilic than either of said electrode or said fluid distribution layer, whereby said porous hydrophilic layer draws water from said electrode through said fluid distribution layer.

26. The electroconductive element according to claim 25, wherein said electrode is a cathode.

27. The electroconductive element of claim 25, wherein said liquid distribution media forms an electrically conductive path between said impermeable electrically conductive element and said fluid distribution layer which is electrically conductive.

28. The electroconductive element of claim 24, wherein said impermeable electrically conductive element and said liquid distribution media are arranged together to define gas flow channels.

29. The electroconductive element of claim 28, wherein said liquid distribution media has an undulated configuration of peaks and valleys, wherein said peaks correspond to land and said valleys correspond to grooves which constitute said flow channels.

30. The electroconductive element of claim 29, wherein said liquid distribution media has a first surface and a second surface, said first surface is in contact with said fluid distribution layer and has an undulating surface that corresponds to said gas flow channels, wherein said second surface is opposite to said first surface and meets with a surface of said impermeable electrically conductive element and is planar.

31. The electroconductive element of claim 24, wherein said porous liquid distribution media has an average pore size in the range of from about 2 to about 30 microns.

32. The electroconductive element of claim 25, wherein said liquid distribution media comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said second layer is relatively more hydrophilic than said first layer.

33. The electroconductive element of claim 25, wherein said liquid distribution media comprises a first and a second layer wherein said first layer is in contact with said impermeable electrically conductive element and said second layer is in contact with said fluid distribution layer wherein said first layer has a larger average pore size than said second layer, such that liquid is transported at a higher rate in said first layer than in said second layer.

34. A method for making an electroconductive element for an electrochemical fuel cell, comprising:

providing an impermeable electrically conductive element having a major surface;

applying a precursor of a liquid distribution media to said major surface; and

treating said precursor to form a hydrophilic liquid distribution media that is adhered to said major surface.

35. The method of making an electroconductive element according to claim 34, wherein said precursor is a metallic material selected from the group consisting of: screen, mesh, and foam.

36. The method of making an electroconductive element according to claim 34, wherein said treating comprises diffusion bonding said precursor to said major surface of said impermeable electrically conductive element.

37. The method of making an electroconductive element according to claim 34, wherein said precursor of said liquid distribution media comprises a plurality of metal particles and a binder.

38. The method of making an electroconductive element according to claim 37, wherein said treating comprises applying heat to volatilize said binder and sinter said plurality of metal particles to one another.

39. The method of making an electroconductive element according to claim 34, wherein said precursor of said liquid distribution media comprises a polymer.

40. The method of making an electroconductive element according to claim 39, wherein said applying comprises spray coating said precursor comprising said polymer on said major surface.

41. The method of making an electroconductive element according to claim 39, wherein said treating comprises applying heat to cure said polymer.

42. The method of making an electroconductive element according to claim 39, wherein said precursor of said liquid distribution media further comprises a plurality of conductive particles and pore-forming constituents.

43. The method of making an electroconductive element according to claim 42, wherein said treating comprises applying heat at a temperature such that said pore-forming constituent volatilizes.

44. The method of making an electroconductive element according to claim 43, wherein said treating further comprises dissolving said pore-forming constituent after said applying heat.

45. The method of making an electroconductive element according to claim 34, wherein said applying comprises attaching a screen to said major surface.

46. The method of making an electroconductive element according to claim 45, wherein said attaching is selected from the group consisting of: diffusion bonding, brazing, and mixtures thereof.

47. The method of making an electroconductive element according to claim 34, wherein said treating comprises etching said liquid diffusion media surface to enhance hydrophilicity.

48. The method of making an electroconductive element according to claim 34, wherein said treating comprises firing said liquid diffusion media surface to enhance hydrophilicity.

49. The method of making an electroconductive element according to claim 34, wherein said treating comprises chemical vapor deposition onto said liquid diffusion media surface to enhance hydrophilicity.

50. A method for distributing water within an electrochemical fuel cell comprising:

introducing reactant gases to a respective anode and cathode of a membrane electrode assembly (MEA);

conducting an electrochemical reaction in said MEA thereby generating water on said cathode side;

transporting water away from said cathode by uptake of water in a porous fluid distribution layer in contact with said cathode;

transferring said transported water to a liquid distribution media contacting said fluid distribution layer; and

distributing said transferred water within said liquid distribution media to wet relatively dry areas of said liquid distribution media.